D Y PATIL INTERNATIONAL UNIVERSITY

AKURDI PUNE

Term Project Report

Biomaterials

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1 Introduction

Nowadays days people are widely using plastic cutlery in marriage and other functions because plastic is cheaper than metals. Plastics are mixtures of organic polymers that play a major role in environmental contamination worldwide. We decided to make Edible cutlery a replacement for plastic cutlery. Edible cutlery is a revolutionary concept in the field of sustainable dining. Made from natural and edible ingredients like sorghum, rice, wheat, and millet, these utensils offer a unique solution to the global plastic pollution crisis. Edible cutlery is eco-friendly and nutritious, as it adds valuable nutrients to your diet. Its biodegradable nature reduces waste and environmental impact, making it a popular choice among environmentally conscious consumers. This innovative product is changing how we eat and paving the way for a greener and healthier future and it is cheaper by the way.

2 Principles

To avoid the use of such non-biodegradable material, edible cutlery has been developed in the Report with all-natural ingredients i.e. the blend of rice, sorghum, and millet. Different flour blends were analyzed for functional properties. We used three different types of samples: sample A, sample B, and sample C samples are differentiated according to the percentage of ingredients. to make cutlery surfaces more hydrophobic we used edible agar gel to coat the cutlery. The samples were baked at 130 or 180 °C, to cock it and make more stiffer. Using flour to make cutlery is very beneficial because the flour has high nutritional values and is less allergic for most people. butter, sugar, and salt are used for the taste.

3 Methodology

3.1 Materials Required

3.1.1 Chemicals and machines

weighing machine, hot plate, heater, and Gravity convection oven. ethanol, strawberry essences, etc.

3.1.2 Raw Materials

Wheat flour (D mart home product), rice flour (D mart home product), sorghum flour (D mart home product), sugar (locally available), butter (amul butter), salt (Tata salt) and Edible agar (sarvar china grass). all were purchased from a D mart Ravet, Pune.

3.2 Procedures

3.2.1 A

The dough was prepared with a blend of rice flour, sorghum flour, and wheat flour to establish three different compositions, Sample A, Sample B, and Sample C. The compositions are recorded in Table 2. Each sample of the blend of flour was added with a constant amount of other ingredients such as sugar, salt, strawberry essence, and butter separately. we made the dough using our hands. The dough was further kneaded by hand for 30 - 60 seconds to form a smooth shape. Pre-sheeting of the dough was carried out by hand then with the help of dough sheeter of desired length and breadth. The sheets of dough were then cut into desired size and shape. The dough was molded into small bowls, and plate then baked in an aluminum tray at 180^{o}C for 20- 60 mins. The utensils were cooled before being carried out for further analysis.

Table no 2

Ingredients(g)	Sample A	Sample B	Sample C
Rice	40	30	30
wheat	30	30	40
sorghum	30	30	40
sugar	15	15	15
salt	0.350	0.350	0.350
Butter	1.5	1.5	1.5
strawberry ess.	Traces	Traces	Traces

3.2.2 B

We mixed the flour from Sample A and Sample C [Rice 35 grams, wheat 35 grams, sorghum 30 grams others kept same] because, after Experiment A, sample B was not suitable for making cutlery. Everything else remained the same. We then made the dough, molded it in an aluminum plate, and placed it in

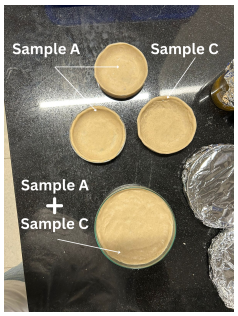

Figure 1: Image after procedure A and B

Figure 2: cutlery in tray

the oven at 180^{o}C for 10 minutes. Afterward, we removed our cutlery from the oven.

For the agar gel coating, we prepared a solution of 0.8 grams of agar (seaweed) in 100 ml of water and then heated it on a hot plate. Once the gel formed, we dipped our molded cutlery in it. After dipping, we removed the cutlery from the gel using forceps and then placed it in the aluminum tray, eventually putting it back in the oven for 20 minutes.

3.2.3 Solubility Test

The test we conducted involved adding hot and cold water to the bowls and observing them. This test is also known as the water-holding capacity (WHC) test, which we are performing to assess the liquid-holding capacity of the cutlery to make them more reliable.

The results were unexpected: the hot water bowl lasted for 1 hour, while the cold water bowl held the water for just 21 minutes.

Figure 3: Solubility Test

Figure 4: biodegradability Test

3.2.4 biodegradability Test

The biodegradability test was conducted in the laboratory. The prepared cutlery was buried in sterile soil inside a beaker, and arranged in layers. The bottom layer consisted of red soil, the middle layer of cutlery, and the top layer again of soil. Water was sprinkled over it.

Result: After 7 days, we observed that the cutlery had degraded and developed a fungus layer on it. Based on this, we conclude that the cutlery is biodegradable.

3.2.5 Oil binding Capacity Test

We dropped oil onto the cutlery and kept it for observation to determine its oil-binding capacity. Since oil is less dense than water, it should be held for a longer time. The results were as expected: the oil was held for approximately 2 hours in the cutlery.

3.2.6 Tensile Test

The tensile strength of cutlery is a measure of its ability to resist stretching or pulling forces without breaking. In our testing, we employed a traditional

method using a stand with a pulley. One side of the pulley was attached to a weight, while the other side was connected to the cutlery.

After conducting the experiment, we found that the cutlery was able to support a weight of up to 530 grams before breaking. This result indicates the strength and durability of the cutlery under tensile forces, providing valuable information for its practical use and longevity.

4 Result

We analyzed various flour blends for their functional properties, as shown in Table 2. Different tests were conducted to determine the most suitable flour for preparing edible cutlery. Sample A and the blend of samples A and C showed the highest water-holding capacity, with time as a parameter, while samples B and C performed poorly. Sample A and Sample A + C contain a higher proportion of rice flour along with sorghum and wheat flour. Therefore, the combined effect of these flours may contribute to the superior water-holding capacity of these samples.

Similarly, the oil-binding capacity of sample A and the combination of samples A and C was higher than the other samples. Samples A and AC passed all the tests. Consequently, we decided to assess other physical appearances.

We decided to rate the cutlery on a '10' rating system. The composition of sample C was not proper, so compared to the other samples, it did not perform well.

Table no 2

Parameters	Sample A	Sample B	Sample AC
Texture	7	5	8
Taste	7	6.9	8
Flavor	4	2	7
Mouth feel	6	4	9
overall acceptability	6	5	9
Remark	Selected	not selected	Widely selected

5 Future Perceptive and Conclusion

future advancements may lead to a wider variety of flavors, shapes, and sizes of edible cutlery. This could make them more appealing to consumers and suitable for various dishes and cuisines. Edible cutlery can be enhanced with added nutrients, such as vitamins, minerals, and fiber, to provide additional health benefits beyond its functional use. Manufacturers may offer customizable options for edible cutlery, allowing consumers to choose flavors, ingredients, or nutritional profiles according to their preferences or dietary needs.Future edible cutlery may be designed to have improved functional properties, such as enhanced strength, longer shelf life, and better resistance to heat and moisture. Due to the damage done by plastic to the earth's ecosystem. edible cutlery

can replace the plastic. edible cutlery can be used in hot beverages, salads and sweets,etc. edible cutlery can be a better alternative for plastic as it is biodegradable,it can provide health benefits,it can be cost-effective when the production of raw materials increases. As the popularity of edible cutlery grows, there may be a need for standardized regulations and certifications to ensure quality, safety, and compliance with food standards.

6 Reference

1.Roy, T.R. and Morya, M. (2022). Edible cutlery: An eco-friendly replacement for plastic cutlery. Journal of Applied and Natural Science, 14(3), 835 - 843. https://doi.org/10.31018/jans.v14i3.3627.

2.Amerine, M, et al. (1965). "Principles of sensory evaluation of food Academic Press." New York/London.

3.Chemists, AOOA and Horwitz, W (1975). Official methods of analysis, Association of Official Analytical Chemists Washington, DC.

4. Leja, K and Lewandowicz, G (2010). "Polymer biodegradation and biodegradable polymers-a review." Polish Journal of Environmental Studies 19(2).

5.J. res. Sci., 2021, 33(1), Dykes, L and Rooney, LW (2006). "Sorghum and millet phenols and antioxidants." Journal of cereal science 44(3): 236-251.

6.El Wakeel, M (2007). Ultra structure and functional properties of some dry mixes of food, Faculty of Agriculture, Ain Shams University Cairo, Egypt .

7.Fritsche, W and Hofrichter, M (2001). "Aerobic degradation by microorganisms." Biotechnology set: 144-167.

8.Godswill, AC and Godspel, AC (2019). "Physiological effects of plastic wastes on the endocrine system (Bisphenol A, Phthalates, Bisphenol S, PBDEs, TBBPA)." International Journal of Bioinformatics and Computational Biology 4(2): 11-29.